CLAIMS.

1. A composite material comprising an inorganic filler material and a fibrous polymeric material characterised in that the fibrous material comprises oriented polymeric fibres and has areas of adjacent oriented fibres fused together to form a network or continuous matrix while retaining fibrous structure in the composite.

2. A composite material as claimed in claim 1 wherein the fused fibres are in chopped form.

3. A composite material as claimed in claim 1 ~~or claim 2~~ being of a substantially void free form.

4. A composite material as claimed in ~~any one of claims 1 to 3~~ claim 1 wherein the inorganic filler is a particulate filler.

5. A composite material as claimed in ~~any one of claims 1 to 4~~ claim 1 wherein the filler is selected from the group consisting of talc, mica, graphite, metal oxides, metal hydroxides, carbonates and phosphates.

6. A composite material as claimed in ~~any one of claims 1 to 5~~ claim 1 wherein the inorganic filler is a biocompatible material.

7. A composite material as claimed in claim 6 wherein the biocompatible material is an apatite.

8. A composite material as claimed in claim 7 wherein the apatite is hydroxyapatite.

9. A composite material as claimed in ~~any one of claims 1 to 8~~ claim 1 wherein the material is of extruded form.

10 A composite material as claimed in claim 9 wherein the material is in hydrostatically extruded form.

11. A composite material as claimed in ~~any one of claims 1 to 10~~ claim 1 having flexural modulus between 7 and 30 GPa.

12. A composite material as claimed in claim 11 having flexural modulus greater than 10 GPa.

13. A composite material as claimed in claim 11 having a flexural modulus greater than 12 GPa.

14. A composite material as claimed in claim 11 having a flexural modulus greater than 15 GPa.

15. A composite material as claimed in ~~any one of claims 1 to 14~~ claim 1 having a flexural strength between 50 and 150 MPa.

16. A composite material as claimed in claim 15 having a flexural strength greater than 60 MPa.

17. A composite material as claimed in claim 15 having a flexural strength greater than 80 MPa.

18. A composite material as claimed in claim 15 having a flexural strength greater than 100 MPa.

19. A composite material as claimed in ~~any one of claims 1 to 18~~ claim 1 having a flexural ductility between 0.5 and 10 %.

20. A composite material as claimed in claim 19 having a flexural ductility between 0.5 and 7%.

21. A composite material as claimed in claim 20 having a flexural ductility between 0.5 and 4%.

22. A composite material as claimed in ~~any one of the preceding claims~~ claim 1 wherein the fibrous polymeric material is a polyolefin.

23. A composite material as claimed in claim 22 wherein the polyolefin is polyethylene.

24. A composite material as claimed in claim 22 wherein the polyethylene is of high modulus.

25. A composite material as claimed in ~~any one of claims 1 to 24~~ claim 1 characterised in that it includes a recrystallized melt phase of the polymeric material which has a melting point less than that of the oriented fibre and which binds the fibre material together.

26. A method for producing a composite material comprising combining oriented polymeric fibres with an inorganic filler material and compressing the combined material using hot compaction
characterised in that it includes
(i) combining the polymeric material with the filler material and maintaining them at a contact pressure at which at least some of the fibres are in intimate contact with each other,
(ii) heating the combined material at an elevated temperature sufficient to melt only a proportion of the polymeric fibre and
(iii) compressing the heated combined material at a compaction pressure.

27. A method as claimed in claim 26 characterised in that the combining is carried out by mixing the materials.

28. A method as claimed in claim 26 wherein the contact pressure and compaction pressure are the same and this allows preferential surface melting of the fibres.

29. A method as claimed in claim 26 characterised in that the compaction pressure is higher than the contact pressure.

30. A method as claimed in claim 26 characterised in that the contact pressure is between 0.5 and 4 Mpa.

31. A method as claimed in any ~~one of the preceding method claims~~ claim 1 characterised in that the proportion of the fibre that melts includes the surface and is from 5 to 95% by weight of the fibre.

32. A method as claimed in claim 31 characterised in that the proportion of the fibre is from 5 to 50% by weight of the fibre.

33. A method as claimed in claim 26 characterised in that the compressed mixture is cooled such that on cooling the melted part of the fibrous polymeric material forms a three dimensional matrix binding the fibrous material and filler material together.

34. A method as claimed in ~~any one of claims 26 to 33~~ claim 26 characterised in that the mixture is maintained at a temperature at least that which an extrapolation of the leading edge of the endotherm of the fibrous material measured by differential scanning calorimetry intersects the temperature axis.

35. A method as claimed in claim 26 characterised in that the temperature at which the mixture is maintained is less than the peak temperature of melting of the polymer fibres as measured by differential scanning calorimetry.

36. A method as claimed in ~~any one of claims 26 to 35~~ claim 26 characterised in that the mixture is maintained at 0.5 to 4 MPa during (i) and (ii) prior to compressing at a compaction pressure.

37. A method as claimed in claim 36 characterised in that the mixture is maintained at between 0.5 and 2 MPa prior to compressing at a compaction pressure.

38. A method as claimed in ~~any one of claims 26 to 37~~ claim 26 characterised in that the fibres are in the form of continuous fibres that have been chopped into smaller lengths.

39. A method as claimed in ~~any one of claims 26 to 38~~ claim 26 characterised in that the temperature at which the mixture is maintained is between 1 and 10°C below the melting point of the polymeric material.

40. A method as claimed in claim 39 characterised in that the temperature is between 1 and 5°C below the melting point of the polymeric material.

41. A method as claimed in ~~any one of claims 26 to 40~~ claim 26 characterised in that the compacted material is subjected to extrusion.

42. A method as claimed in claim 41 characterised in that the extrusion step is carried out by hydrostatic extrusion.

43. A method as claimed in claim 41 ~~or 42~~ characterised in that the product from step (iii) or the extrusion step is powderised then reprocessed as in steps (i) to (iii).

44. A method as claimed in claim 43 characterised in that the reprocessed material is then subjected to extrusion.

45. A method as claimed in claim 44 characterised in that the extrusion is hydrostatic extrusion.

46. A method as claimed in claim 42 ~~or claim 45~~ wherein the hydrostatic extrusion step is performed by (iv) placing a billet of the material in contact with a die orifice while being surrounded by a fluid medium, (v) heating then fluid and the billet to a temperature below

the melting point of the polymeric component of the material and (vi) applying pressure to the fluid such as to cause the billet to be extruded through the die.

47. A method as claimed in claim 46 characterised in that the die is a convergent die.

48. A method as claimed in claim 46 or 47 wherein the extrusion ratio of the extruded product is 3:1 or more.

49. A method as claimed in ~~any one of claims 41 to 48~~ claim 41 wherein the extrusion ratio is 7:1 or more.

50. A method as claimed in ~~any one of claims 41 to 49~~ claim 41 wherein the extrusion ratio is at least 11:1.

51. A method as claimed in claim 42 ~~or 45~~ characterised in that the fluid is an oil.

52. A method as claimed in ~~any one of claims 26 to 51~~ claim 26 characterised in that the compaction pressure used in step (iii) is from 5 to 1000MPa.

53. A method as claimed in claim 52 characterised in that the compaction pressure used in step (iii) is from 20 to 500 Mpa.

54. A method as claimed in claim 53 characterised in that the compaction pressure is from 40 to 80MPa.

55. A composite or method as claimed in ~~any one of claims 1 to 54~~ claim 1 wherein the polymer is a homo or co-polymer of a polyolefin.

56. A composite or method as claimed in claim 55 wherein the polymer has a weight average molecular weight of 50,000 to 3,000,000.

57. A composite or method as claimed in claim 56 wherein the polymer has a weight average molecular weight of 100,000 to 3,000,000.

58. A composite or method as claimed in claim 57 wherein the polymer has a weight average molecular weight of 500,000 to 3,000,000.

59. A composite or method as claimed in ~~any one of claims 55 to 59~~ claim 55 characterised in that the fibre is gel or melt spun fibre.

60. A structural material comprising a composite as claimed in or provided by a method as claimed in ~~any one of the preceding claims~~ claim 1.

61. A prosthesis comprising a material as claimed in claim 61.